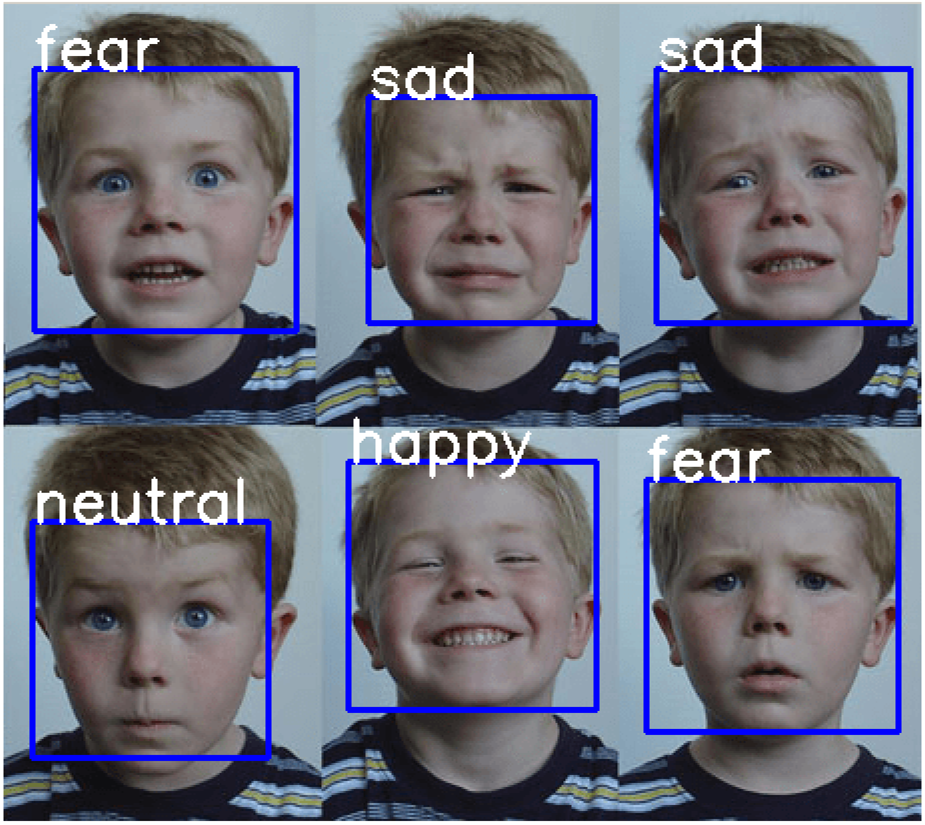
AI Model for Detecting Facial Expressions



Team Name:

Aya Taha Fayrouz
Fatma Gamal Mohamed
Omar Samy Abd El-Aziz
Reem Younis Mohamed
Sara Tarek Gouda

Introduction

This Project Focusing on developing an AI model that's capable of accurately detecting the facial expressions, leading to getting insights into human emotions and feelings.
By this technology we will have a significant application in fields like Psychology behavior, Mental health, Marketing, Security and Human-Computer interactions.

Problem Statement

The diversity of human interactions, colors, face shapes and ages were a challenge to us to make a model that can analyze and detect the expressions we want.

During the model training we encountered an accuracy problem that leads us to try different models in order to achieve an appropriate accuracy. Will discuss these models later.

Data Collection

We used a dataset from Kaggle that's contains 5406 Images of many different humans and classified it into 8 expressions.

We identified the classes as the following:
Anger = 712, Contempt = 618, Disgust = 672, Fear = 622, Happy = 791, Neutral = 514
Sad = 603, Surprise = 874.

Model Architecture

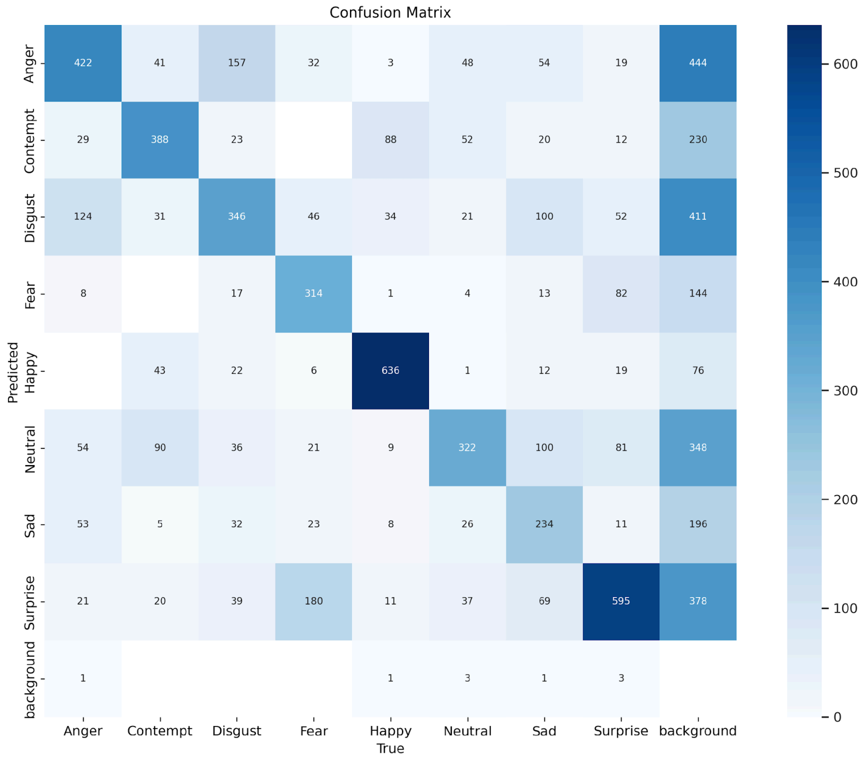
We used different models with that dataset including:
Faster R-CNN with ResNet50 & with VGG16
YOLO v8
YOLO v10B network 8n
YOLO v10B network 10n
The following table will show you the precisions we got from these models:

Model Name	Mean Average precision (mAP)
Faster R-CNN with ResNet50	0.24
Faster R-CNN with VGG16	0.26
YOLO v8 s	0.68
YOLO v10B network 8n	0.73
YOLO v10B network 10n	0.78

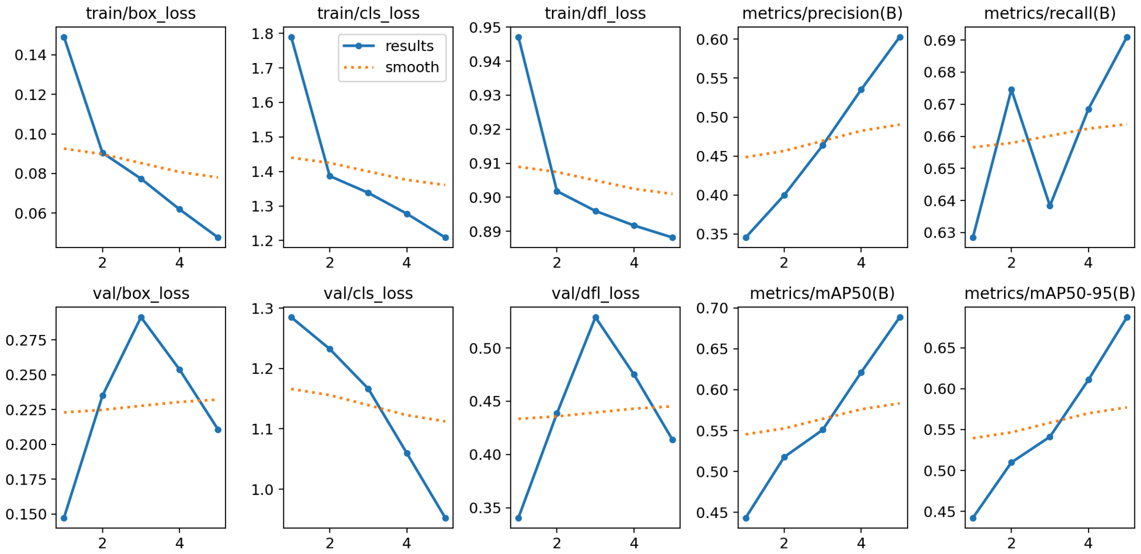
So, in the End we decided to use YOLO v10 Balanced model with architecture network 10n.

Training and Validation

As mentioned above we got the best results with YOLO v10 B so we completed our project with that model and trained the model with parameters [16 patch, 22 epochs, Adam optimizer using weight_decay 0.0005].



In the Validation we used Precision to get accurate metrics by using:
mAP50 (mean Average Precision at IoU threshold 0.5)
mAP75 (mean Average Precision at IoU threshold 0.75)
mAP50-95 (mean Average Precision across multiple IoU thresholds from 0.5 to 0.95) to comprehensively evaluate your model.



Results and Analysis

Based on the results we got:

High Accuracy for Happy and Neutral Expressions: The model achieved high accuracy (>90%) for detecting happy and neutral expressions, indicating robust performance in these categories.

Challenges with Anger Recognition: Anger recognition showed lower precision compared to other emotions, suggesting the need for more diverse training data or model adjustments.

Overall Performance: The model's overall accuracy is more than 85% demonstrates its effectiveness in identifying facial expressions across different scenarios with average speed of 7 ms.

Conclusion

In this project, we investigated the performance of different deep learning models for object detection on the AffectNet dataset formatted for YOLO. we trained YOLOv8s and YOLOv10b models and achieved higher mean average precision (mAP) with YOLOv10b. While YOLOv8s might be a consideration for its efficiency, YOLOv10b demonstrated superior accuracy in this specific task. To achieve a balance between accuracy and efficiency, we then exported the PyTorch model to ONNX format. This conversion enabled faster inference and deployment on various platforms. Finally, we successfully deployed the ONNX model locally using FastAPI, showcasing its functionality in a real-world application.

References

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